Practitioner's Docket No.: 789_129 ***PATENT***

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of: Hiroshi KURACHI, Yuichi SASAKI and Takeya MIYASHITA

Serial No.: 10/807,859 Group Art Unit: 1795

Filed: March 24, 2004 Examiner: Matthew J. Merkling

Conf. No.: 5516

For: GAS SENSOR

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CERTIFICATION OF EFS TRANSMISSION

I hereby certify that this paper is being transmitted via EFS to the Patent and Trademark Office on July 21, 2008.

Janet M. Stevens

Janet M. Stevens

DECLARATION UNDER 37 CFR '1.132

Sir:

I, Takeya Miyashita, a citizen of Japan hereby declare and state:

1. I have a Bachelors degree in Material Processing which was conferred upon me by Tohoku University in Japan, in 1991.

2. I have been employed by NGK Insulators, Ltd. since 1991 and I have had a total of 17 years of work and research experience in automotive and industrial ceramics.

3. I am one of the inventors in the above-identified patent application. I am familiar with the prosecution history of the above-identified patent application, including the PTO positions and references applied in the Final Office Action mailed February 22, 2008.

4. The following experiments were conducted by me or under my direct supervision.

[A] Gas Sensor Response Time and Sensor Failure (Cracking Voltage) Test

Test Setup:

Test device: LNG burner stand
Tgas: 350°C ± 20°C
Gas velocity: 10 m/s ± 2 m/s
Gas condition: $0.9 \leq \lambda \leq 1.1$

[A](1) Gas Sensor Response Time Test Procedure:

(1) Begin recording output of gas sensor.

(2) Start flow of gas in test chamber.

(3) Apply DC voltage to sensor controller for sensor operation.

(4) When output of gas sensor changes, record as gas sensor response time.

(5) End of test.

[A](2) Gas Sensor Failure Test Procedure:

(1) Apply DC voltage to gas sensor heater at room temperature.

(2) Continue applying DC voltage to gas sensor for 30 seconds.

(3) Cool down gas sensor.

(4) Apply DC voltage in 1 volt increments if gas sensor doesn't fail (cracks).

(5) Continue applying DC voltage to gas sensor for 30 seconds.

(6) Cool down gas sensor.

(7) Repeat step(4)-(6) until gas sensor fails (cracks)

(8) Record voltage at which gas sensor cracked. End of test.

[A](3) Gas Sensor Response Time/Failure Test Results:

The gas sensor response time and failure test results with respect to the claimed Wc/We

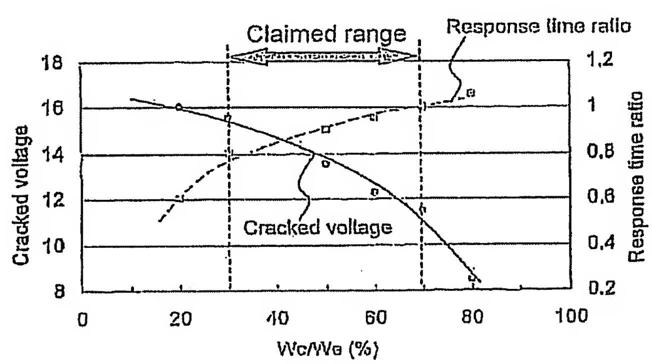
ratio of the gas sensors are shown in Fig. 1. Note that each value plotted on Fig. 1 is the average of five samples. The response time ratio shown in Fig. 1 is the response time of the gas sensor relative to the response time of the reference gas sensor where Wc/We equals 70%.

As shown in Fig. 1:

- When Wc/We equals 20%, the gas sensor exhibits a high resistance to cracking (16V), however, the response time of the gas sensor is much slower, taking 40% longer to respond than the reference gas sensor.

- When Wc/We equals 30%, the gas sensor exhibits a high resistance to cracking (14V) and the response time of the gas sensor is slower, but within 20% of the reference gas sensor response time.
- When Wc/We equals 70%, the gas sensor exhibits an acceptable resistance to cracking (11.6V) and the gas sensor exhibits a good response time.
- When Wc/We equals 80%, the response time of the gas sensor is better than the response time of the reference gas sensor, however, the gas sensor exhibits a very low resistance to cracking failing at 8.2V.
- The test data demonstrates that the greater the width of the gas opening (Wc), the better the response time of the gas sensor, but increasing the gas opening width also reduces the resistance to cracking of the gas sensor.

Fig. 1 $\frac{Wc}{We}$ Response Time Test Results



[B] Gas Sensor Light-off Time and Sensor Failure (Cracking Voltage) Test

[B] (1) Gas Sensor Light-off Time Test Procedure:

(1) Begin recording output of gas sensor.
(2) Apply DC voltage to sensor controller for sensor operation at room temperature, record time.
(3) When output of gas sensor stabilizes, record time.
(4) Gas sensor light-off time is difference between (2) and (3).
(5) End of test.

[B] (2) Gas Sensor Failure Test Procedure:

(1) Apply DC voltage to gas sensor heater at room temperature.
(2) Continue applying DC voltage to gas sensor for 30 seconds.
(3) Cool down gas sensor.
(4) Apply DC voltage in 1 volt increments if gas sensor doesn't fail (cracks).
(5) Continue applying DC voltage to gas sensor for 30 seconds.
(6) Cool down gas sensor.
(7) Repeat step(4)-(6) until gas sensor fails (cracks)
(8) Record voltage at which gas sensor cracked. End of test.

[B](3) Gas Sensor Light-off Time/Sensor Failure Test Results:

The results of the test are shown in Fig. 2. Each value applied to Fig. 2 is an average of five samples. The light-off time ratio shown in Fig. 2 is the ratio relative to the light-off time of the reference gas sensor, where La/We equals 30%.

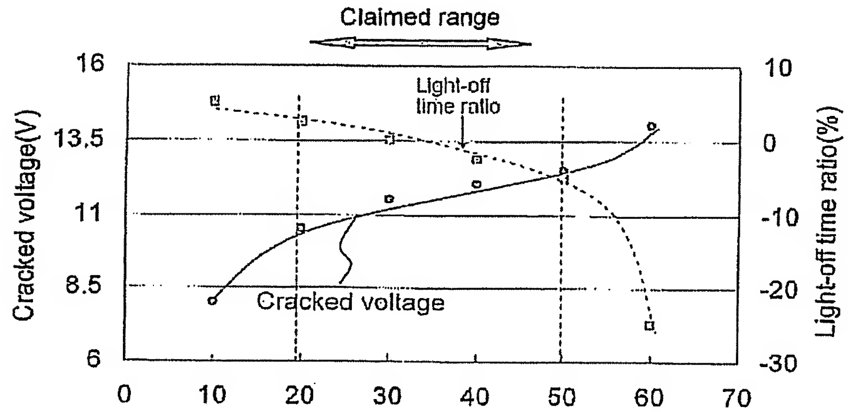
As shown in Fig. 2:

- When the La/We ratio is 10%, the gas sensor light-off time is better (i.e., faster) than the reference gas sensor, however, the gas sensor exhibits a very low resistance to cracking, failing at 8.2V.
- When the La/We ratio equals 20%, the gas sensor light-off time is better than the reference gas sensor and the gas sensor exhibits an acceptable resistance to cracking (10.7V).

- When the gas sensor La/We ratio equals 30%, the gas sensor exhibits a good resistance to cracking (11.3V) and the gas sensor light-off time is good.
- When the La/We ratio of the gas sensor is 40%, the gas sensor light-off time is good, within 5% of the reference gas sensor, and the gas sensor exhibits very high resistance to cracking, not failing until the voltage exceeded 12V.
- When the La/We ratio of the gas sensor is 50%, the gas sensor light-off time is good, within 7% of the reference gas sensor, and the gas sensor exhibits very high resistance to cracking, not failing until the voltage exceeded 12V.
- When the La/We ratio of a gas sensor is 60%, the gas sensor exhibits excellent resistance to cracking, not failing until the voltage exceeded 13.5V, but the light-off time for the gas sensor is unacceptably slow taking over 25% longer than the reference gas sensor.

The test data demonstrates that moving the end of the heater further away from the end of the gas sensor decreases the thermal stress in the area of a gas opening, preventing cracking from occurring, but this movement of the heater also decreases the temperature of the main pumping means of the gas sensor, which results in a longer light-off time until the sensor output becomes stable and increases the time required for (i) the gas sensor to respond to a change in the measured gas, and (ii) for the output of the gas sensor to stabilize (i.e., light-off time).

Fig. 2 $\frac{La}{We}$ Light-off Time Test Results



5. I hereby declare that all statements made herein of my own knowledge are true, and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine and/or imprisonment under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing therefrom.

Date: July 11, 2008 Takeya Miyashita

Takeya Miyashita